PATENT ABSTRACTS OF JAPAN

(11)Publication number : 07-040208
(43)Date of publication of application : 10.02.1995

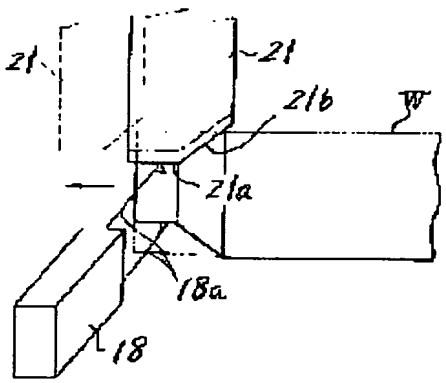
(51)Int.Cl. B24B 5/04
B24B 1/00

(21)Application number : 05-194495
(22)Date of filing : 05.08.1993

(71)Applicant : TOYODA MACH WORKS LTD
(72)Inventor : KITAJIMA MASATO
MUKAI RYOHEI
SUGIYAMA KAZUHISA
NAYA TOSHIAKI
HATTORI KAZUYA

(54) GRINDING METHOD

(57)Abstract:
PURPOSE: To extensively shorten machining cycle time by way of shortening time until the time when a sizing signal is provided.
CONSTITUTION: After rapidly advancing a grinding wheel 21 against a work W to a position including machining allowance for rough-grinding+precise grinding, the work W is advanced to the left by a specified amount and the machining allowance is roughly ground by traverse grinding, and thereafter, by advancing the grinding wheel 21, the work W is finely ground by plunge grinding until a sizing signal is provided from a sizing device 18, and at the stage when the sizing signal is provided, by advancing the work W to the left, it is transferred to one pass traverse grinding.



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[Date of sending the examiner's decision of rejection]	
[Kind of final disposal of application other than the examiner's decision of rejection or application converted registration]	
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[Patent number]	3555146
[Date of registration]	21.05.2004
[Number of appeal against examiner's decision of rejection]	
[Date of requesting appeal against examiner's	

* NOTICES *

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CLAIMS

[Claim(s)]
[Claim 1] The headstock which carries out revolution actuation of the work, and the wheel spindle stock which carries out revolution actuation of the emery wheel which has a grinding side parallel to axis of rotation of said work, The driving means which makes the relative displacement of said headstock and wheel spindle stock carry out in the direction of axis of rotation of said work to the direction list in which said work and emery wheel carry out access alienation mutually, It is the grinding approach which carries out traverse grinding of the work by having constant ****** which measures the path of said work, and carrying out relative displacement of said headstock and wheel spindle stock by said driving means. The 1st process fast forwarded in the direction in which work and an emery wheel carry out access alienation of said wheel spindle stock of each other by said driving means to the slightly larger location to work than constant **** of pair Perilla frutescens (L.) Britton var. crispa (Thunb.) Decne., The 2nd process which the relative displacement of said headstock and wheel spindle stock is made to carry out in the direction of an axis of rotation of work by said driving means, and carries out specified quantity traverse grinding of the work from an end after said rapid-traverse termination, The 3rd process which is made to carry out relative displacement and carries out plunge cutting until a standard size signal is obtained from said constant ****** in the direction in which work and an emery wheel carry out access alienation of said headstock and wheel spindle stock of each other by said driving means after said 2nd process termination, The grinding approach equipped with the 4th process which the relative displacement of said headstock and wheel spindle stock is made to carry out in the direction of an axis of rotation of work by said driving means, and carries out traverse grinding of the work with one pass after the 3rd process termination.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] This invention relates to the grinding approach which carries out traverse grinding of the work with one pass using the grinding stone which has a grinding side parallel to the grinding side which inclines to the cylinder side of work, and the cylinder side of work.
[0002]
[Description of the Prior Art] As work is shown in the grinding stone for carrying out traverse grinding with one pass at drawing 4 (a), the comparatively thin emery wheel 1 which has rough grinding side 1a which inclines to the cylinder side of Work W, and finish grinding side 1b parallel to the cylinder side of Work W is used. When carrying out traverse grinding of the work with one pass conventionally using such an emery wheel As shown in drawing 4 (a), first, the work W which carried out center support of the ends by the headstock and tail stock By advancing an emery wheel 1 in the direction (the direction of a plunge) close to work in the state of [this] dividing to the location as for which that left end side carries out phase opposite with an emery wheel 1, as Work W is shown in drawing 4 (b), plunge cutting is carried out to the order of rough **, A Juridical Foundation the Institute of Clinical Psychiatry, and fine **. And when the standard size signal was outputted from the sizing device 2 at the time of fine grinding, slitting delivery of an emery wheel 1 was stopped, and traverse grinding of the work W was carried out with one pass by moving Work W to the left of drawing 4 (b) after that.
[0003]
[Problem(s) to be Solved by the Invention] However, by the conventional grinding approach mentioned above, since the approach of shifting to traverse grinding is taken after cutting deeply to constant ****** with plunge cutting and applying delivery, the processing cycle time of work will become long. It is because the grinding force radial [concerning the work at the time of plunge cutting] of the key factor is large, and work moreover tends to bend, so the feed rate of the direction of a plunge cannot be enlarged.
[0004] The place which this invention solves the conventional problem mentioned above, and is made into the object is to offer the grinding approach which shortens time amount until a standard size signal is outputted, and can shorten the processing cycle time substantially.
[0005]
[Means for Solving the Problem] The headstock to which this invention carries out revolution actuation of the work in order to attain the above-mentioned object, The wheel spindle stock which carries out revolution actuation of the emery wheel which has a grinding side parallel to axis of rotation of said work, The driving means which makes the relative displacement of said headstock and wheel spindle stock carry out in the direction of axis of rotation of said work to the direction list in which said work and emery wheel carry out access alienation mutually, It is the grinding approach which carries out traverse grinding of the work by having constant ****** which measures the path of said work, and carrying out relative displacement of said headstock and wheel spindle stock by said driving means. The 1st process fast forwarded in the direction in which work and an emery wheel carry out access alienation of said wheel spindle stock of each other by said driving means to the slightly larger location to work than constant **** of pair Perilla frutescens (L.) Britton var. crispa (Thunb.) Decne., The 2nd process which the relative displacement of said headstock and wheel spindle stock is made to carry out in the direction of an axis of rotation of work by said driving means, and carries out specified quantity traverse grinding of the work from an end after said rapid-traverse termination, The 3rd process which is made to carry out relative displacement and carries out plunge cutting until a standard size signal is obtained from said constant ****** in the direction in which work and an emery wheel carry out access alienation of said headstock and wheel spindle stock of each

other by said driving means after said 2nd process termination, It was made the configuration equipped with the 4th process which the relative displacement of said headstock and wheel spindle stock is made to carry out in the direction of an axis of rotation of work by said driving means, and carries out traverse grinding of the work with one pass after the 3rd process termination.

[0006]

[Function] Since plunge cutting of the parts for a remaining finishing machining allowance is carried out after that by the above-mentioned configuration by leaving a part for a finishing machining allowance and carrying out traverse grinding of the work at the 2nd process, after passing through the 1st process and it shifts to one pass traverse grinding, time amount until a standard size signal is obtained is shortened. Therefore, the processing cycle time of work can be shortened substantially.

[0007]

[Example] Hereafter, the example of this invention approach is explained based on a drawing. Drawing 1 is the block diagram of the whole cylindrical grinder which applied this invention approach. In drawing 1 , it is numerical-control equipment with which 10 controls a cylindrical grinder and 30 controls a cylindrical grinder 10.

[0008] A cylindrical grinder 10 is equipped with the wheel spindle stock 13 installed in X shaft orientations movable on the work table 12 installed movable on the bed 11 at Z shaft orientations, and a bed 11.

[0009] The work table 12 is moved to Z shaft orientations by the feed screw of the figure abbreviation rotated with the servo motor 14 and this servo motor 14 which were attached in the bed 11. A servo motor 14 is controlled by numerical-control equipment 30.

[0010] On the work table 12, a headstock 15 and tail stock 16 are located in right and left, and opposite installation is carried out. Ends support of the work W is carried out by the chuck 17 prepared in main shaft 15a of a headstock 15, and center 16a of tail stock 16. Moreover, the sizing device 18 of the in process type which measures the diameter of processing of Work W is installed in the work table 12, and the measurement signal of the work W measured by this sizing device 18 is inputted into numerical-control equipment 30.

[0011] A wheel spindle stock 13 is moved to X shaft orientations by the feed screw of the figure abbreviation rotated with the servo motor 20 and this servo motor 20 which were attached in the bed 11. A servo motor 20 is controlled by numerical-control equipment 30. Moreover, a wheel spindle stock 13 is equipped with the wheel spindle 22 which supports an emery wheel 21, and the drive motor 23 which carries out the high-speed revolution of the emery wheel 21 by peripheral-speed 160 m/s, and it is connected by the revolution transfer devices 24, such as a belt, between the drive motor 23 and the wheel spindle 22.

[0012] An emery wheel 21 has finish grinding side 21a parallel to the cylinder side of Work W, and rough grinding side 21b which inclines to the cylinder side of Work W.

[0013] Numerical-control equipment 30 is equipped with the central processing unit (it calls for short Following CPU) 31 which controls and manages the whole grinder, the memory 32 which stores data, such as the result of an operation in the processing program and CPU31 of Work W, the pulse distributors 33 and 34 which carry out distribution sending out of the driving pulse according to the command value from CPU31, and the interface 35 which deliver and receive data with the exterior as shown in drawing 1 .

[0014] The servo motor 14 for table delivery is connected to said pulse distributor 33 through the actuation circuit 36, and the servo motor 20 for wheel spindle stock delivery is connected to the pulse distributor 34 through the actuation circuit 37 in it. Moreover, the input unit 38 which has the operating button which inputs a sizing device 18 and control data, a grinding initiation command, etc., the CRT display section, etc. is connected to the interface 35.

[0015] Next, it explains with reference to the flow chart and drawing 3 which show actuation of this example constituted as mentioned above to drawing 2 . In the condition of having been equipped with Work W proper between main shaft 15a of a headstock 15, and tail stock 16, a processing program starts by pushing ****** (un-illustrating) of an input unit 38.

[0016] First, Work W rotates with the drive motor of the figure abbreviation built in the headstock 15, and an emery wheel 21 rotates at the rate of predetermined. CPU31 decodes the grinding stone rapid-traverse advance command by which reading appearance was carried out from memory 32 according to the processing program, and supplies it to a pulse distributor 34. Revolution actuation of the servo motor 20 is carried out, and X shaft orientations are made to carry out rapid-traverse advance of the wheel spindle stock 13 from a pulse distributor 34 in connection with this by sending out the pulse signal according to an advance command, and supplying this pulse signal to the actuation circuit 37 (step S1).

[0017] The rapid-traverse advance location of the emery wheel 21 at this time is equal to the location of the

emery wheel 21 at the time of completing rough ** and A Juridical Foundation the Institute of Clinical Psychiatry which stated with the conventional technique, as shown in drawing 3 . Moreover, the physical relationship of the work W at this time and an emery wheel 21 becomes, just before finish grinding side 21b of an emery wheel 21 contacts the end-face corner of the work W before processing, as shown in the broken line of drawing 3 .

[0018] If rapid-traverse advance of an emery wheel is performed to a location including the above-mentioned rough ** and the machining allowance for A Juridical Foundation the Institute of Clinical Psychiatry, CPU31 will decode the table **** command by which reading appearance was carried out from memory 32, and will supply it to a pulse distributor 33. In connection with this, by sending out the pulse signal according to a table **** command, and supplying this pulse signal to the actuation circuit 36, revolution actuation of the servo motor 14 is carried out, and specified quantity (necessary minimum movement magnitude which can measure diameter of processing of Work W by sizing device 18) **** of the work table 12 is carried out from a pulse distributor 33 (step S2).

[0019] If the work table 12 is ****(ed), as Work W is shown in the dashed line of drawing 3 , rough grinding of the machining allowance which is equivalent to the part for conventional rough ** + A Juridical Foundation the Institute of Clinical Psychiatry from a left end with rough grinding side 21b of the emery wheel 21 to rotate will be carried out by traverse grinding. Since the grinding method at this time is traverse grinding, grinding force radial [concerning Work W] is small, and the feed rate of the traverse direction is substantially made greatly from the feed rate of the direction of a plunge in connection with this.

[0020] After the traverse rough grinding of the predetermined die length by **** of the work table 12 is completed, CPU31 performs grinding stone fine ****** processing shown in step S3. That is, at step S3, by supplying a fine ****** command signal from CPU31 to a pulse distributor 34 according to a processing program, by sending out the pulse signal according to fine ********** from a pulse distributor 34, supplying this pulse signal to the actuation circuit 37, and carrying out revolution actuation of the servo motor 20, as a wheel spindle stock 13 is advanced with the feed rate according to fine ****** and shown in the continuous line of drawing 3 , fine grinding of the work W is carried out with plunge cutting.

[0021] In the following step S4, as shown in drawing 3 , it judges whether feeler 18a of a sizing device 18 was engaged with the periphery of the fine grinding part of Work W, this measured the diameter of processing of Work W, the path signal was inputted into CPU31, and the diameter of processing of the work W by which fine grinding is carried out reached constant **. When there is no standard size signal, it returns to step S3 and a wheel spindle stock 13 is made to fine-****** further here. Moreover, when those with a standard size signal are judged, fine ****** by plunge cutting is stopped and it progresses to step S5.

[0022] The work table 12 is made to **** with the feed rate according to a **** command at step S5 by sending out the pulse signal according to a table **** command from a pulse distributor 33, supplying this pulse signal to the actuation circuit 36, and carrying out revolution actuation of the servo motor 14 by supplying a table **** command signal to a pulse distributor 33 from CPU31 according to a processing program. Thereby, Work W covers an overall length and traverse grinding is carried out with one pass.

[0023] After traverse grinding to Work W is completed, it progresses to step S6 and rapid-traverse retreat of the wheel spindle stock 13 is carried out at the rate according to a retreat command by the rapid-traverse retreat command from CPU31. And the work table 12 is made to **** and it is made to return to a former location by the table **** command from CPU31 in the following step S7. Thereby, processing of one work W is completed.

[0024] After carrying out rapid-traverse advance of the wheel spindle stock 13 to Work W in above this examples to a location including the conventional machining allowance for rough ** + A Juridical Foundation the Institute of Clinical Psychiatry, by carrying out specified quantity **** of the work table 12 By rough-**(ing) a part for the above-mentioned machining allowance with traverse grinding, carrying out fine grinding until it advances a wheel spindle stock 13 and a standard size signal is obtained by plunge cutting after that, and ****(ing) the work table 12 in the phase where the standard size signal was obtained Since it considered as the configuration which carries out traverse grinding of the work W with one pass, time amount until a standard size signal is obtained can be shortened substantially. in order [moreover,] to decide the advance location of a wheel spindle stock 13 based on a standard size signal -- heat -- the predetermined diameter of a dimension can be made to Work W without being influenced of a variation rate.

[0025] Grinding time amount until it has been 2 seconds to traverse rough **, and has been 6 seconds and a total of 8 seconds at fine **, if it is in the grinding method of this example, although it required for rough ** at 6 seconds and had required for A Juridical Foundation the Institute of Clinical Psychiatry a total of 18

seconds for 6 seconds at 6 seconds and fine **, when a grinding method until a standard size signal is incidentally obtained was held with the conventional plunge cutting, and a standard size signal is obtained is made to 1/2 or less [conventional]. As for this, grinding force radial [concerning the work piece when carrying out traverse grinding of the conventional machining allowance for rough ** + A Juridical Foundation the Institute of Clinical Psychiatry] is small, and it is because the feed rate of the traverse direction can be enlarged. Consequently, the processing cycle time of work can be shortened substantially.
[0026] In addition, this invention approach is applicable also to what sends a wheel spindle stock in the angular direction which inclined to axis of rotation of work, and axis of rotation of what [not only] sends a wheel spindle stock in the right-angled direction but work. Thus, various deformation is possible unless it deviates from the range which it was not limited to the thing of a configuration of being shown in the above-mentioned example, but was indicated to the claim.
[0027]
[Effect of the Invention] Since the wheel spindle stock was fast forwarded in this invention to the location which left a part for a finishing machining allowance to work, and specified quantity traverse grinding of the work was carried out from this location, and it considered as the grinding cycle method which shifts to traverse grinding of one pass after carrying out plunge cutting until the standard size signal was obtained after that as explained above, the time of grinding until a standard size signal is obtained is shortened, and the processing cycle time of work can be substantially shortened by this.

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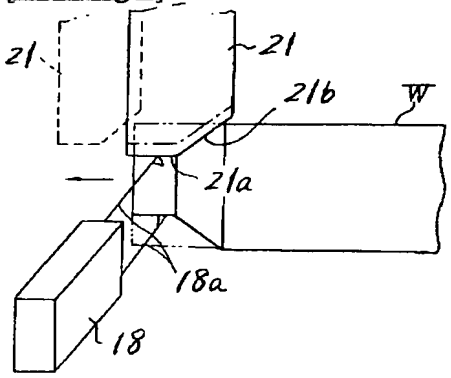
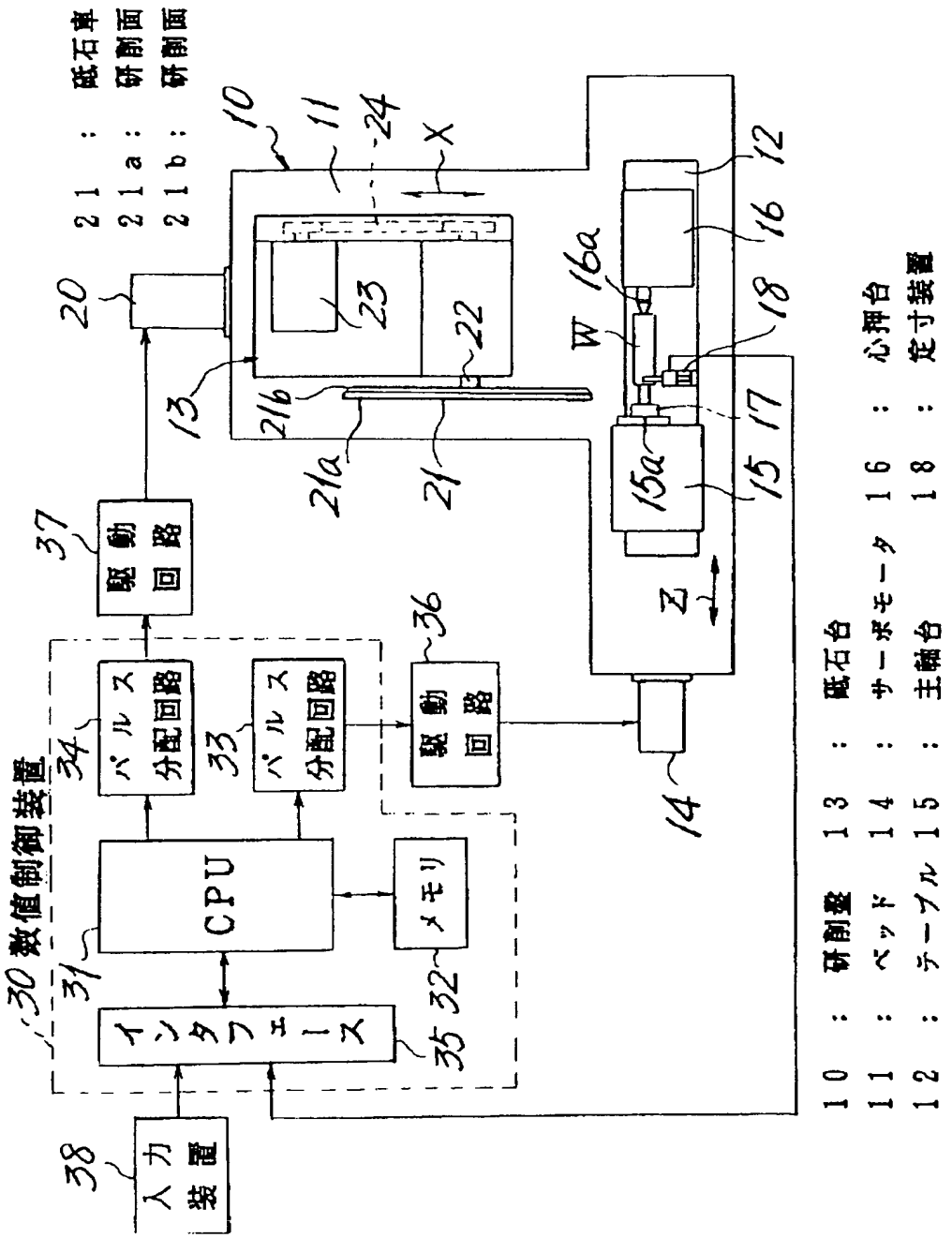
DRAWINGS

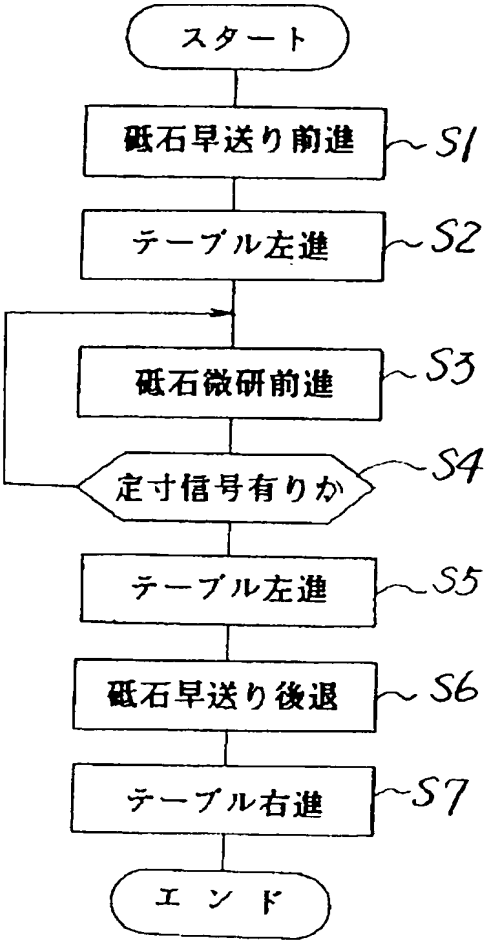
[Drawing 3]



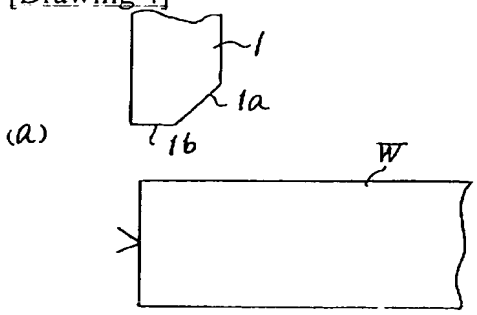
[Drawing 1]

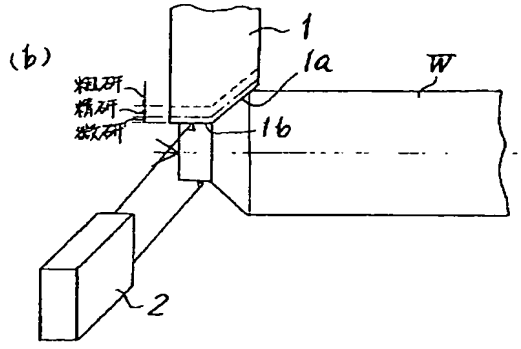

21 : 砥石車
21a : 研削面
21b : 研削面
10 : 研削盤
11 : ベッド
12 : テーブル
13 : 砥石台
14 : サーボモータ
15 : 主軸台
16 : 心押台
18 : 定寸装置
数値制御装置
CPU
メモリ
インタフェース
パルス分配回路
パルス分配回路
駆動回路
駆動回路
入力装置
W
Z
X

[Drawing 2]


スタート
砥石早送り前進
S1
テーブル左進
S2
砥石微研前進
S3
定寸信号有りか
S4
テーブル左進
S5
砥石早送り後退
S6
テーブル右進
S7
エンド

[Drawing 4]


(a)
1
1a
1b
W


(b)
1
1a
W
粗研
精研
微研
1b
2

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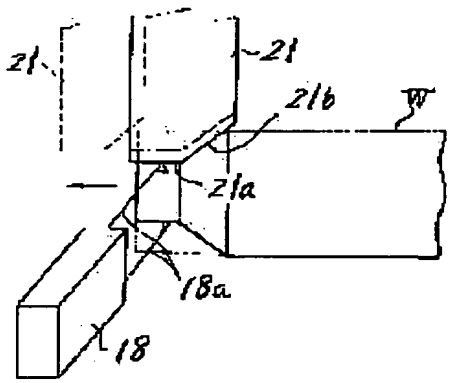

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[Date of extinction of right]

(19)日本国特許庁（ＪＰ）　(12) 公開特許公報（A）　(11)特許出願公開番号

特開平7－40208

(43)公開日　平成７年(1995)２月10日

(51)Int.Cl.[6]		識別記号	庁内整理番号	ＦＩ	技術表示箇所
Ｂ２４Ｂ	5/04		9325－3C		
	1/00	Ｚ	9325－3C		

審査請求　未請求　請求項の数１　ＯＬ　（全 6 頁）

(21)出願番号　特願平5－194495

(22)出願日　平成５年(1993)８月５日

(71)出願人　000003470
豊田工機株式会社
愛知県刈谷市朝日町１丁目１番地

(72)発明者　北島　正人
愛知県刈谷市朝日町１丁目１番地　豊田工機株式会社内

(72)発明者　向井　良平
愛知県刈谷市朝日町１丁目１番地　豊田工機株式会社内

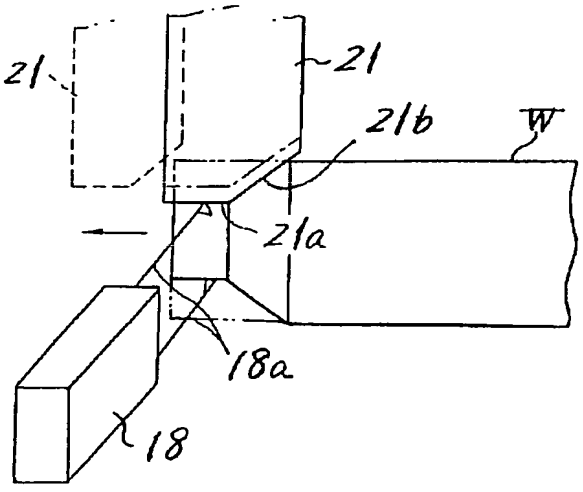
(72)発明者　杉山　和久
愛知県刈谷市朝日町１丁目１番地　豊田工機株式会社内

(74)代理人　弁理士　門間　正一

最終頁に続く

(54)【発明の名称】　研削方法

(57)【要約】
【目的】　定寸信号が得られるまでの時間を短縮し、加工サイクルタイムを大幅に短縮することを目的とする。
【構成】　砥石車２１を工作物Ｗに対し、従来の粗研＋精研分の取代を含めた位置まで早送り前進させた後、工作物Ｗを所定量左進させて上記取代分をトラバース研削で粗研し、その後、砥石車２１を前進させてプランジ研削により定寸装置１８から定寸信号が得られるまで微研削し、定寸信号が得られた段階で工作物Ｗを左進してワンパストラバース研削に移行させる。



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【特許請求の範囲】

【請求項１】　工作物を回転駆動する主軸台と、前記工作物の回転軸線と平行な研削面を有する砥石車を回転駆動する砥石台と、前記工作物と砥石車とが互いに接近離間する方向並びに前記工作物の回転軸線方向に前記主軸台と砥石台を相対移動させる駆動手段と、前記工作物の径を測定する定寸手段とを有し、前記主軸台及び砥石台を前記駆動手段により相対移動させることで工作物をトラバース研削する研削方法であって、

前記駆動手段により前記砥石台を工作物に対しその定寸径より僅かに大きい位置まで工作物と砥石車とが互いに接近離間する方向に早送りする第１の工程と、前記早送り終了後に前記主軸台及び砥石台を前記駆動手段により工作物の回転軸線方向に相対移動させて工作物を一端から所定量トラバース研削する第２の工程と、前記第２の工程終了後に前記主軸台及び砥石台を前記駆動手段により工作物と砥石車とが互いに接近離間する方向に前記定寸手段から定寸信号が得られるまで相対移動させてブランジ研削する第３の工程と、第３の工程終了後に前記主軸台及び砥石台を前記駆動手段により工作物の回転軸線方向に相対移動させて工作物をワンパスでトラバース研削する第４の工程とを備える研削方法。

【発明の詳細な説明】

【０００１】

【産業上の利用分野】本発明は、工作物の円筒面に対して傾斜する研削面と、工作物の円筒面と平行な研削面を有する砥石を用いてワンパスで工作物をトラバース研削する研削方法に関する。

【０００２】

【従来の技術】工作物をワンパスでトラバース研削するための砥石には、図４（ａ）に示すように、工作物Ｗの円筒面に対して傾斜する荒研削面１ａと、工作物Ｗの円筒面と平行な仕上研削面１ｂとを有する、比較的薄い砥石車１が使用される。従来、このような砥石車を用いて工作物をワンパスでトラバース研削する場合は、まず、図４（ａ）に示すように、両端を主軸台と心押台によりセンタ支持した工作物Ｗを、その左端側が砥石車１と相対向する位置まで割出し、この状態で砥石車１を工作物に接近する方向（ブランジ方向）に前進させることにより、工作物Ｗを図４（ｂ）に示す如く粗研、精研、微研の順にブランジ研削する。そして、微研削時に定寸装置２から定寸信号が出力された時点で砥石車１の切り込み送りを停止し、その後、工作物Ｗを図４（ｂ）の左方へ移動することにより、工作物Ｗをワンパスでトラバース研削していた。

【０００３】

【発明が解決しようとする課題】しかしながら、上述する従来の研削方法では、ブランジ研削により定寸位置まで切り込み送りをかけた後、トラバース研削へ移行する方法を採っているため、工作物の加工サイクルタイムが

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長くなってしまう。その主要因は、ブランジ研削時の工作物にかかる半径方向の研削抵抗が大きく、しかも工作物が撓み易いため、ブランジ方向の送り速度を大きくできないからである。

【０００４】本発明は、上述した従来の問題を解決するもので、その目的とするところは、定寸信号が出力されるまでの時間を短縮し、加工サイクルタイムを大幅に短縮できる研削方法を提供するにある。

【０００５】

【課題を解決するための手段】上記目的を達成するために本発明は、工作物を回転駆動する主軸台と、前記工作物の回転軸線と平行な研削面を有する砥石車を回転駆動する砥石台と、前記工作物と砥石車とが互いに接近離間する方向並びに前記工作物の回転軸線方向に前記主軸台と砥石台を相対移動させる駆動手段と、前記工作物の径を測定する定寸手段とを有し、前記主軸台及び砥石台を前記駆動手段により相対移動させることで工作物をトラバース研削する研削方法であって、前記駆動手段により前記砥石台を工作物に対しその定寸径より僅かに大きい位置まで工作物と砥石車とが互いに接近離間する方向に早送りする第１の工程と、前記早送り終了後に前記主軸台及び砥石台を前記駆動手段により工作物の回転軸線方向に相対移動させて工作物を一端から所定量トラバース研削する第２の工程と、前記第２の工程終了後に前記主軸台及び砥石台を前記駆動手段により工作物と砥石車とが互いに接近離間する方向に前記定寸手段から定寸信号が得られるまで相対移動させてブランジ研削する第３の工程と、第３の工程終了後に前記主軸台及び砥石台を前記駆動手段により工作物の回転軸線方向に相対移動させて工作物をワンパスでトラバース研削する第４の工程とを備える構成にした。

【０００６】

【作用】上記の構成により、第１の工程を経た後、第２の工程で工作物を仕上げ取代分を残してトラバース研削し、その後、残りの仕上げ取代分をブランジ研削してワンパストラバース研削へ移行するから、定寸信号が得られるまでの時間が短縮される。よって、工作物の加工サイクルタイムを大幅に短縮することができる。

【０００７】

【実施例】以下、本発明方法の実施例を図面に基づいて説明する。図１は、本発明方法を適用した円筒研削盤の全体の構成図である。図１において、１０は円筒研削盤、３０は円筒研削盤１０を制御する数値制御装置である。

【０００８】円筒研削盤１０は、ベッド１１上にＺ軸方向に移動可能に設置した工作物テーブル１２、およびベッド１１上にＸ軸方向に移動可能に設置した砥石台１３を備える。

【０００９】工作物テーブル１２は、ベッド１１に取り付けたサーボモータ１４および該サーボモータ１４によ

り回転される図略の送りねじとによりＺ軸方向に移動される。サーボモータ１４は数値制御装置３０により制御される。

【００１０】工作物テーブル１２上には、主軸台１５と心押台１６が左右に位置して対向設置されている。工作物Ｗは、主軸台１５の主軸１５ａに設けたチャック１７と、心押台１６のセンタ１６ａにより、両端支持される。また、工作物テーブル１２には、工作物Ｗの加工径を測定するインプロセスタイプの定寸装置１８が設置されており、この定寸装置１８で測定された工作物Ｗの測定信号は数値制御装置３０に入力される。

【００１１】砥石台１３は、ベッド１１に取り付けたサーボモータ２０および該サーボモータ２０により回転される図略の送りねじとによりＸ軸方向に移動される。サーボモータ２０は数値制御装置３０により制御される。また、砥石台１３は、砥石車２１を支持する砥石軸２２と、砥石車２１を周速１６０ｍ／ｓで高速回転させる駆動モータ２３を備え、駆動モータ２３と砥石軸２２間はベルト等の回転伝達機構２４により連結されている。

【００１２】砥石車２１は、工作物Ｗの円筒面と平行な仕上研削面２１ａと、工作物Ｗの円筒面に対して傾斜する荒研削面２１ｂを有する。

【００１３】数値制御装置３０は、図１に示すように、研削盤全体を制御し管理する中央処理装置（以下ＣＰＵと略称する）３１と、工作物Ｗの加工プログラムおよびＣＰＵ３１での演算結果などのデータを格納するメモリ３２と、ＣＰＵ３１からの指令値に応じて駆動パルスを分配送出するパルス分配回路３３，３４、および外部とのデータの授受を行うインタフェース３５を備える。

【００１４】前記パルス分配回路３３には、駆動回路３６を介してテーブル送り用のサーボモータ１４が接続され、また、パルス分配回路３４には、駆動回路３７を介して砥石台送り用のサーボモータ２０が接続されている。また、インタフェース３５には、定寸装置１８、及び制御データ、研削開始指令などを入力する操作釦、ＣＲＴ表示部等を有する入力装置３８が接続されている。

【００１５】次に、上記のように構成された本実施例の動作を図２に示すフローチャートおよび図３を参照して説明する。主軸台１５の主軸１５ａと心押台１６間に適正に工作物Ｗが装着された状態において、入力装置３８の研削釦（不図示）が押されることにより、加工プログラムがスタートする。

【００１６】まず、主軸台１５に内蔵された図略の駆動モータにより工作物Ｗが回転され、かつ砥石車２１が所定の速度で回転される。ＣＰＵ３１は、加工プログラムに従いメモリ３２から読み出された砥石早送り前進指令を解読して、パルス分配回路３４に供給する。これに伴いパルス分配回路３４からは前進指令に応じたパルス信号が送出され、このパルス信号を駆動回路３７に供給することにより、サーボモータ２０を回転駆動して砥石台

１３をＸ軸方向に早送り前進させる（ステップＳ１）。

【００１７】このときの砥石車２１の早送り前進位置は、図３に示すように、従来技術で述べた粗研と精研が完了した時点における砥石車２１の位置と等しい。また、このときの工作物Ｗと砥石車２１との位置関係は、図３の破線に示すように、砥石車２１の仕上研削面２１ｂが加工前の工作物Ｗの端面角部に接触する直前となる。

【００１８】上記粗研と精研分の取代を含めた位置まで砥石車の早送り前進が行われると、ＣＰＵ３１は、メモリ３２から読み出されたテーブル左進指令を解読してパルス分配回路３３に供給する。これに伴いパルス分配回路３３からはテーブル左進指令に応じたパルス信号が送出され、このパルス信号を駆動回路３６に供給することにより、サーボモータ１４を回転駆動して工作物テーブル１２を所定量（定寸装置１８により工作物Ｗの加工径を測定できる必要最小限の移動量）左進させる（ステップＳ２）。

【００１９】工作物テーブル１２が左進されると、工作物Ｗは、図３の１点鎖線に示すように、回転する砥石車２１の荒研削面２１ｂによって左端から従来の粗研＋精研分に相当する取代がトラバース研削により粗研削される。このときの研削方式はトラバース研削であるため、工作物Ｗにかかる半径方向の研削抵抗は小さく、これに伴いトラバース方向の送り速度はプランジ方向の送り速度より大幅に大きくできる。

【００２０】工作物テーブル１２の左進による所定長さのトラバース粗研削が終了すると、ＣＰＵ３１は、ステップＳ３に示す砥石微研前進処理を実行する。即ち、ステップＳ３では、加工プログラムにしたがいＣＰＵ３１からパルス分配回路３４に対し微研前進指令信号を供給することにより、パルス分配回路３４から微研指令信号に応じたパルス信号が送出され、このパルス信号を駆動回路３７に供給してサーボモータ２０を回転駆動することにより、砥石台１３を微研指令に応じた送り速度にて前進させ、工作物Ｗを図３の実線に示すように、プランジ研削により微研削する。

【００２１】次のステップＳ４では、図３に示すように、定寸装置１８のフィーラ１８ａを工作物Ｗの微研削部位の外周に係合し、これにより工作物Ｗの加工径を測定して、その径信号をＣＰＵ３１に入力し、微研削される工作物Ｗの加工径が定寸に達したかを判定する。ここで、定寸信号がない場合はステップＳ３に戻って砥石台１３をさらに微研前進させる。また、定寸信号有りが判定されたときはプランジ研削による微研送りを停止させてステップＳ５に進む。

【００２２】ステップＳ５では、加工プログラムにしたがいＣＰＵ３１からテーブル左進指令信号をパルス分配回路３３に供給することにより、パルス分配回路３３からテーブル左進指令に応じたパルス信号を送出し、この

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パルス信号を駆動回路３６に供給してサーボモータ１４を回転駆動することにより、工作物テーブル１２を左進指令に応じた送り速度にて左進させる。これにより工作物Wは全長に亘りワンパスでトラバース研削される。

【００２３】工作物Wに対するトラバース研削が終了すると、ステップＳ６に進み、ＣＰＵ３１からの早送り後退指令により、砥石台１３を後退指令に応じた速度にて早送り後退させる。そして、次のステップＳ７において、ＣＰＵ３１からのテーブル右進指令により、工作物テーブル１２を右進させ、元位置へ復帰させる。これにより、１つの工作物Wの加工が終了する。

【００２４】上述のような本実施例においては、砥石台１３を工作物Wに対し、従来の粗研＋精研分の取代を含めた位置まで早送り前進させた後、工作物テーブル１２を所定量左進させることにより、上記取代分をトラバース研削で粗研し、その後、砥石台１３を前進させてプランジ研削により定寸信号が得られるまで微研削し、定寸信号が得られた段階で工作物テーブル１２を左進することにより、工作物Wをワンパスでトラバース研削する構成としたので、定寸信号が得られるまでの時間を大幅に短縮できる。又、定寸信号を基に砥石台１３の前進位置を決めるため、熱変位の影響を受けないで工作物Wを所定の寸法径に仕上げることができる。

【００２５】因みに、定寸信号が得られるまでの研削方式を従来のプランジ研削で行った場合、粗研に６秒、精研に６秒、微研に６秒、計１８秒要していたが、本実施例の研削方式にあっては、トラバース粗研に２秒、微研に６秒、計８秒となり、定寸信号が得られるまでの研削時間は、従来の１／２以下にできる。このことは、従来の粗研＋精研分の取代をトラバース研削するときのワークにかかる半径方向の研削抵抗が小さく、トラバース方向の送り速度を大きくできるからである。その結果、工作物の加工サイクルタイムを大幅に短縮することができる。

【００２６】なお、本発明方法は、工作物の回転軸線と直角な方向に砥石台を送るものに限らず、工作物の回転＊

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＊軸線に対し傾斜したアンギュラ方向に砥石台を送るものにも適用できる。このように、上記実施例に示す構成のものに限定されず、請求項に記載した範囲を逸脱しない限り、種々の変形が可能である。

【００２７】

【発明の効果】以上説明したように、本発明においては、砥石台を工作物に対し仕上げ取代分を残した位置まで早送りし、この位置から工作物を所定量トラバース研削し、その後、定寸信号が得られるまでプランジ研削した後、ワンパスのトラバース研削へ移行する研削サイクル方式としたので、定寸信号が得られるまでの研削時が短縮され、これによって工作物の加工サイクルタイムを大幅に短縮することができる。

【図面の簡単な説明】

【図１】本発明方法を適用した研削装置の全体構成を示すブロック図である。

【図２】本実施例における工作物の研削手順を示すフローチャートである。

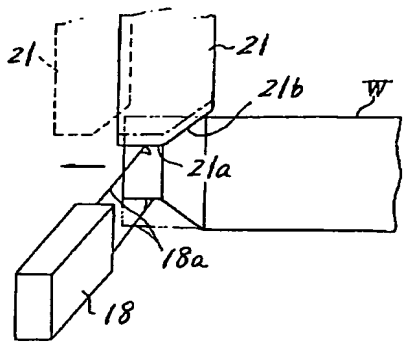
【図３】本実施例による研削動作時の工作物と砥石車との関係を示す説明図である。

【図４】従来の研削方式による工作物と砥石車との関係を示す説明図である。

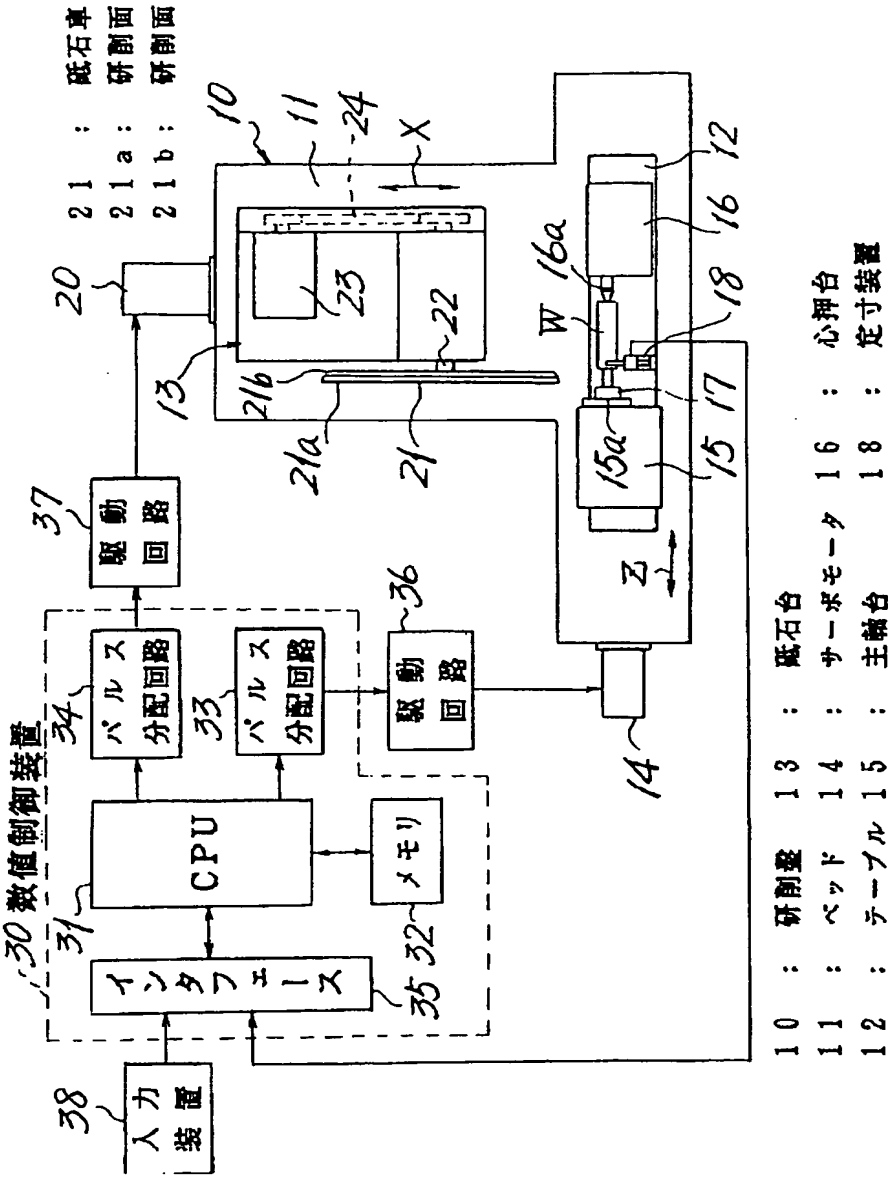
【符号の説明】

１０　研削盤
１２　工作物テーブル
１３　砥石台
１４　サーボモータ（駆動手段）
１５　主軸台
１６　心押台
１８　定寸装置
２０　サーボモータ（駆動手段）
２１　砥石車
３０　数値制御装置
３１　ＣＰＵ
３２　メモリ
Ｗ　工作物

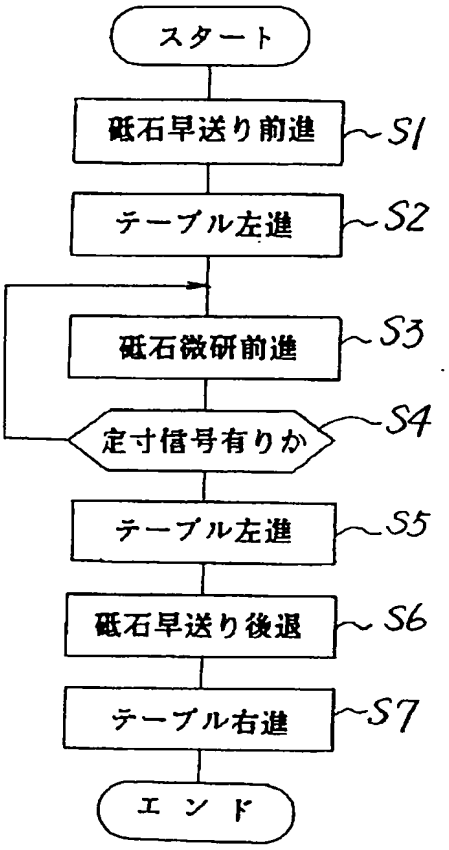
【図３】



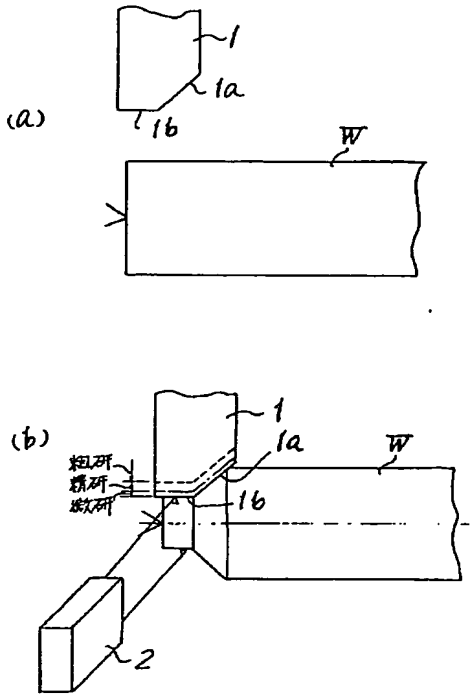
【図1】


21 : 砥石車
21a : 研削面
21b : 研削面
10 : 研削盤　13 : 砥石台
11 : ベッド　14 : サーボモータ　16 : 心押台
12 : テーブル　15 : 主軸台　18 : 定寸装置
数値制御装置
CPU
メモリ
インタフェース
パルス分配回路
パルス分配回路
駆動回路
駆動回路
入力装置
X
Z
W

【図２】



【図４】



フロントページの続き

(72)発明者　納谷　敏明
愛知県刈谷市朝日町１丁目１番地　豊田工機株式会社内

(72)発明者　服部　和也
愛知県刈谷市朝日町１丁目１番地　豊田工機株式会社内